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A Review on Effect of Stress and Strain Distribution on the AA5083 With Respect to Different Channel Angle of ECAP

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Abstract

The focus of this study was on the effect of channel angle on stress distribution in the material aluminum alloy 5083. The mechanical properties of a material are related to the grain size. Equal channel angular pressing (ECAP) is a method for deforming materials in such a way that a strong mechanical properties material is formed while the dimensions of the work piece stay fixed in order to make ultra-fine-grained materials. One of the parameters of ECAP is the channel angle. It's crucial to understand the impact of a die channel angle on material stress distribution before designing one. When the work piece passes through the channel angle, the die channel angle is built differently to see the effect of stress distribution. At the place where the die's channels angle intersected, the grain structure was evaluated. The result of the influence of die channel angle on stress distribution is shown in this study's analysis. It is well established that the channel angle has an impact on mechanical behaviour. The inhomogeneity index (C_i) and standard deviation (S.D.) are two approaches for assessing strain homogeneity. C_i is demonstrated to be an ineffective tool for analysing strain distribution homogeneity. Furthermore, it is advised that constructing Equal Channel Angular Pressing die geometry to obtain the best strain circulation homogeneity rather also the best efficient strain consequence is preferable.

1. Introduction

Due to the unique physical and mechanical quantities inherent to UFG component, the Severe Plastic Distortion technique has been widely employed for characterization alteration and development according to (Gzyl et al.). Segal and colleagues developed the equal channel angular pressing (ECAP) technique in the 1980s in Minsk, the previous Soviet Union, along the object of developing a metal forming process along a rank strain rate. The concept of SPD stems from the ability to bend a material in a small region while allowing the work piece to amass huge amounts of plastic strain without material fracture or failure. Severe plastic deformation (SPD) has been a centre of research for the manufacture of bulk nanostructured and ultra-fine grained (UFG) materials for decades, according to earlier studies (Sanusi, Makinde, and Oliver). ECAP is a technique in which a process of pure shear deformation can be repeatedly forced on materials to produce a severe plastic strain while keeping the work piece's cross-sectional dimensions unchanged (Azushima et al.). It is a clear approach to enhance the strength of metallic alloys through grain refinement employing ECAP, which introduces an extensive plastic strain into materials after recurrent pressing (Vishnu et al.). Due to the increased primary deformation zone and shortened deforming time, the influence of corner angle on the strain rate is significantly larger than that of channel angle, according to ECAP simulation (Bagherpour et al.). In compared to conventional grain (CG) size metals and alloys, the materials for UFG developed by ECAP have much greater tensile characteristics and appropriate ductility. The influence of ECAP grain refinement on the improvement of the mechanical characteristics of Al and its alloys has been explained in several prior publications (AAL and SADAWY). High strength, enhanced fatigue resistance, and exceptional formability are the key benefits of UFG metals. In terms of their typical structural features, UFG materials processed by ECAP differ qualitatively and quantitatively from their CG counterparts without changing shape, yielding materials with ultra-fine grains and significantly different attributes in comparison to CG materials (Sklenicka et al.). The grain size influences the manner of deformation and defines the grain refinement mechanism. For varied channel angles and hydro-static pressure conditions, deformation along the die is inhomogeneous during pressing (Samsudin, Kurniawan, and Nor). It has been demonstrated that shifting the microstructure from coarse grain to ultra-fine or nanostructured improves the deformation ability (Ebrahimi, Pashmforoush, and Gode).

These characteristics, without a doubt, have an impact based on microstructure and, ultimately, the equity of ultra-fine grain component. Segal's Equal Channel Angular Pressing is the most popular widely used SPD technique as improving mechanical characteristics and super-plastic behaviour while reducing grain size. One of the most essential criteria is the grain size of the material, consequence the mechanical behaviour about field deposit and alloys in all Severe Plastic Deformation techniques, including Equal Channel Angular Pressing , High Pressure Torsion, Accumulative Roll Bonding, Constrained Groove Pressing, Accumulative Back Extrusion, Tubular Channel Angular Pressing, and so on.

In process ECAP, Two intersecting channels with the same cross-sections are used to press a sample with an outside corner angle Ψ of and a die channel angle of Φ. Because of the accumulating shear strain, each pass is more difficult, During this method, billets with a high plastic strain value can be manufactured. In the frictionless condition, estimates the amount of shear strain after one pass ECAP:

$\gamma = 2cot\left(\frac{\Phi+\Psi}{2}\right) + \Psi cosec\left(\frac{\Phi+\Psi}{2}\right)$ ...1

As well, the size of plastic strain that is equal (ε_{eq}) after N Number of passes is provided by the given relationship:

$\varepsilon_{eq} = \frac{N}{3^{-1/2}}\left(2cot\left(\frac{\Phi+\Psi}{2}\right) + \Psi cosec\left(\frac{\Phi+\Psi}{2}\right)\right]$ 2

As illustrated in Fig. 1, there are four basic paths in the ECAP process between each recurrent pressing.

The following are some of them: path A, in which is pressed the sample repeatedly require being rotated, path B_A, The sample is rotated in this method 90^0 degrees in the opposite behests centrally passes, Route B_C rotates the sample in the same direction by 90^0 degrees, while route C rotates the sample by 180^0 degrees between passes. These techniques produce diverse slip systems in the specimen, resulting in a variety of micro-structures and mechanical properties. So far, so good. Many experiments have been carried out to determine the impact of various On the microstructure, there are a number of pressing paths. Texture and, as a result, mechanical qualities of the completed sample Komura et al investigations's (Kamaruddin, Shahira, and Katimon).

The optimal ductility of super-plastics is attained by path B_C owing to the quickest production of equiaxed grains with high-angle grain borders (Djavanroodi et al.), according to the design of Equal Channel Angular Pressing variables placed on strain uniformity of distribution (HAGBs). Ruslan Z. Valiev et al found that path B_C is the mainly popular successful in grain refinement, while route BA is the least effective. Also, Elongated grains result from pathways B_A and C. Tongetal looked at how ECAP pathways affected the mechanical and microstructure characteristics of admixture. According to the findings, route B_C is the mainly competent in terms of grain refinement and HAGB

TABLE 1. Pure AA5083 mechanical qualities before and after ECAP procedure up to 8 passes by route A

No. of Passes	Pass No.0	Pass No.1	Pass No.2	Pass No.3	Pass No.4	Pass No.8
Yield Strength (MPa)	44	92	123	141	150	158
Ultimate Tensile Strength (MPa)	88	149	171	180	191	197
Elongation (%)	41	24	20	19	19	17

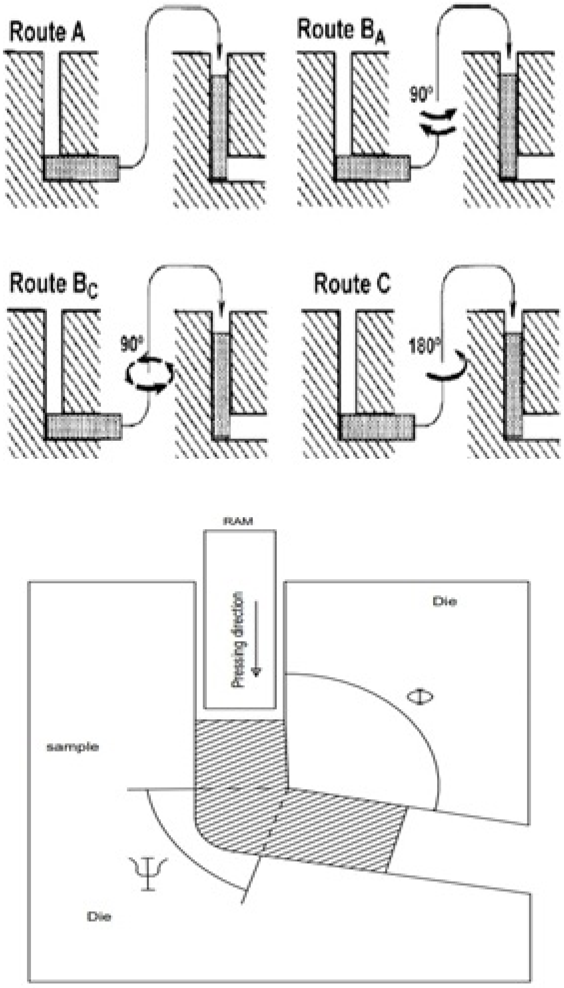

FIGURE 1. Four basic routes in the Equal Channel Angular Pressing process and Sample Passes through Channel.

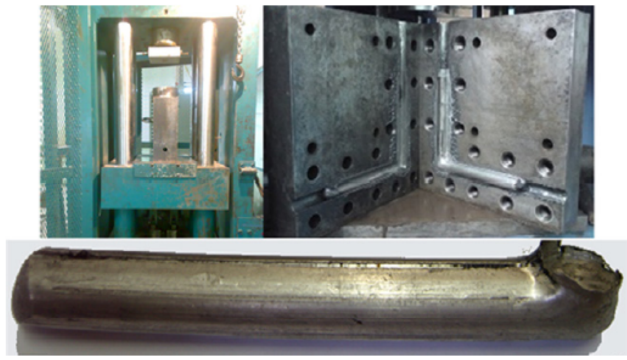

FIGURE 2. After one pass pressing, Equal Channel Angular Pressing die andAA5083 billet.

generation, Route A, on the other hand, is the least competent. Furthermore, Kimand shown that routes A and B$_A$ result in the least homogeneous strain distribution, while routes C and B$_C$ result in the most uniform strain dispersal (Djavanroodi et al.).

Several numerical studies, on the contrary, have been carried out to study the consequences of various Equal Channel Angular Pressing factors Considering the effect of temperature on the effective strain value, coefficient of friction, die channel angle, material characteristics, speed of the ram, outer corner angle, and strain distribution uniformity, material flow and the required pressing force value. Al though Eq. (2) represents the magnitude of the average effective strain activated on the sample each time you pass, depending on various process parameters, different parts of the workpiece (in both the transverse and longitudinal planes) incident fluctuate strain values. In familiar, The degree of homogeneity in strain distributions can be determined in two ways. One is in the Li et al. homogeneity index (C$_i$):

$C_i = \frac{\varepsilon_{max} - \varepsilon_{min}}{\varepsilon_{avg}}$ ...3

The greatest, minimum, and average plastic strains are denoted by, accordingly. In homogeneity index(C$_i$) has been utilised by a number of researchers to investigate the uniformity of strain distributions. The strain dispersal uniformity improves as the magnitude C$_i$ decreases. This component is simply dependent on the highest, minimum, and plastic strain magnitudes on average, according to Eq. (3). S.D. is a mathematical coefficient used in the second technique. This metric is also used in statistical analysis in a variety of scientific and humanities domains. S.D. was used to measure the homogeneity of the strain distribution in this investigation.

$$S.D. = \sqrt{\sum_{i=1}^{n} \left(\varepsilon_{i-}\varepsilon_{avg}\right)^2 /2} \;....4$$

where is the amount of the plastic strain in the node, is the moderate price of plastic strain retrieved from every node, and n is the the billet's number of nodes. As is well known, a high S.D. attitude denotes non-uniform spread of strains. Despite a integer of studies on the ECAP process routes' efficiency and the effects of different Equal Channel Angular Pressing variables on strain behaviour, there is no work has been done to far to draft Equal Channel Angular Pressing dies placed on the best strain behaviour. Around this paper, The homogeneity index (C_i) and standard deviation (S.D.) were used to compare the uniformity of Equal Channel Angular Pressing procedure strain circulation for different routes (S.D.).

Additionally, path A was utilised to investigate are two types of strains parameters because it produces the least homogeneous strain dissemination & the level of strain heterogeneity grows when numbers to pass are added. Likewise, By method A, the Equal Channel Angular Pressing process is carried out demonstration on financial purity aluminium for up to 8 shoots. Tensile testing and microstructure inspection were used to illustrate the improved characteristics of Equal Channel Angular Pressed AA5083. Different die channel angles have different effects. (70^0, 90^0, 105^0 & 120^0) and angle of the outer corner (0^0, 20^0 and $\pi - \Psi$) up to 8 passes on the strain behavior have been numerical analysis was performed. Completely, The optimum strain distribution uniformity was used to create the ECAP dies (Carazo et al.).

2. Materials and Methods

2.1. Materials

Because of the appealing features of the materials, the technology of creating ultra-fine grained materials utilising ECAP has piqued industry interest. High hardness, high yield strength, enhanced toughness, and ductility with increasing strain rate are among the mechanical features of these materials. ECAP has successfully treated a variety of materials, including aluminium and its alloys. The recorded minimum in pressed materials with ultra-fine grain sizes is slower than in the same material in a coarse-grained stable condition, which appears anomalous for high-purity aluminium under some stress and temperature testing conditions. The materials tested are aluminium alloy 5083, a commonly used aluminium that was one of the first materials to succeed in the ECAP process when it was first introduced. When the aluminium alloy passes through the ECAP die with the features listed in Table 3, the properties can show how the strain will be

2.2. Methods

In an ECAP die with a designated channel angle, the deformation behaviour of a square cross-sectioned sample with dimensions of 1.5cm x 1.5cm x 16cm. The material attributes assigned were in general, and the work-piece was covered in plastic. The process tools, including the ECAP die, were modelled as discrete stiff pieces, and the billet was modelled as a deformable sample (Eivani et al.). The ECAP die is made up of two channels with identical rectangular cross sections that are joined at a specified channel angle of 90°, 110°, or 130° through the intersection. The goal of this research is to create an ultra-fine grained material utilising the ECAP process, with all of the parameters listed in Table 4 for the dies and workpiece dimensions.

Table 4 shows the dimensions of each component. The sample's design must be deformable and shell-like. The mesh is 0.5 mm in size. During the initial remeshing operation, the number of elements was raised and remained constant throughout the simulation. The mesh size is 1 mm, and both the internal and external die are expected to be stiff. The assembly is done by creating an instance with three parts: internal and exterior parts, as well as the work piece. We use surface to surface contact (explicit) for both dies to provide interaction for the internal and exterior. From the top surface to the bottom surface of the die, and from one end to the other end of the deforming work piece, there is always a non-uniform strain distribution. Different loading circumstances were simulated, with the only difference being the condition at the entry end against the condition at the exit end, with the geometry, boundary conditions, and meshes remaining unchanged. By applying a zero displacement boundary condition along the X and Y directions, both the inner and outer channel surfaces were considered to be stiff and stationary. The first boundary conditions were chosen as the reference point, with the types of symmetry/antisymmetry/encastre, and encastre was cho-

TABLE 2. ECAP die design for 8 passes based on the uniformity of strain distribution in the including directive

Pass Number	S.D	Φ & Ψ
1	0.03	70^0 & 20^0
2	0.032	70^0 & 20^0
3	0.045	70^0 & 20^0
4	0.065	70^0 & 20^0
5	0.079	70^0 & 20^0
6	0.09	70^0 & 20^0
7	0.107	70^0 & 20^0
8	0.151	70^0 & 20^0

TABLE 3. AA 5083 Chemical Composition and Material Properties

Material	AA 5083								
ρ	2680								
μ	0.38								
E	78X10^9								
YS	0.017	15.818	55.859	102.385	189.843	302.208	315.258	347.458	358.589
PS	0.00008	0.00010	0.00083	0.00184	0.00384	0.0083	0.0098	0.0107	0.0129
Element	Si	Fe	Cu	Mn	Mg	Zn	Ti	Cr	Al
% Present	0.4	0.4	0.1	0.4-1.0	4.0-4.9	0.25	0.15	0.05-0.25	Balance

TABLE 4. Parameter for die geometry and sample geometry of angle 90°, 110°, and 130°

Part	Length (mm)	Height (mm)	Fillet	Angle (^{0})
Die Internal 1	20	20	0.5	
Die External 1	22	22	0.6	90^0
Sample	4	18	-	
Die Internal 2	20	20	0.5	
Die External 2	22	22	0.6	110^0
Sample	4	18	-	
Die Internal 3	20	20	0.5	
Die External 3	22	22	0.6	130^0
Sample	4	18	-	

sen to observe each direction. The top edges of the sample were chosen for the second boundary condition, and the displacement/rotation step process was used. For the Y direction, the displacement values for 90°, 110°, and 130° are -35, -45, and -30, respectively. The maximum force of 550 pounds is applied to the top of the workpiece to extrude the material using the ECAP technique (Mousavi et al.).

3. Experimental Procedure

Commercial aluminium alloy 5083 was employed in this investigation, It was annealed for 1 hour at 375^0 and cooled slowly in the furnace. Before pressing, specimen had a diameter of 20.7 mm, which was the similar as the ECAP die channel diameter, and a length of 190 mm, and were well lubricated with MoS_2. An Equal Channel Angular Pressing die with a 90^0-degree channel angle, a 20^0-degree angle of the outer corner, and a 20.8-mm channel diameter was designed and fabricated. The ram speed was kept constant (2.5 mm/s), and the Equal Channel Angular Pressing procedure was carried out at up to 8 passes at room temperature using route A. To arrange for the tensile examination, samples were refined from the billet centre with their longitudinal axes parallel to the pressing axis, as per ASTM B567M. Optical microscopy as the Scanning electron microscopy and the first billet for During the ECAP procedure, the Equal Channel Angular Pressed billet was employed to assure grist size reduction. Accurate stress-strain connection in extensible examination yielded quantity of strain hardening coefficient (K=153 MPa) and strain hardening apostle (n=0.308). The punch and die were meant to be stiff. The ram speed was given the value of 2 mms^{-1}. Mesh sensitivity diagrams were produced to study in order to identify the best mesh size, the results must be converged and the suitable mesh element size must be chosen. To allow for significant deformations in calculated, the highest mesh member counts were set as 11,050 and certain again meshing was applied. The friction coefficient was chosen to be 0.14, and all analyses were carried out at room temperature. Other key parameters might alter the pressing force during the process, which is a crucial aspect in metal forming. If the stroke impress in the reproduction matches the punch force in the experiment at the same punch position and under the same conditions, different die channel angles (Φ=70^0, 90^0, 105^0 & 120^0) and outer corner angles (Ψ=0^0, 20^0 & $\pi - \Psi$) were near up to 8 strokes via path A. A total of 98 runs can be generated by combining these scenarios. The effects of die channel angle, angle of the outer corner, and stroke number on effective strain magnitude and strain distribution uniformity have been researched. Finally, The die design was reviewed based on these factors to provide the best strain distribution uniformity (Sadasivan, Balasubramanian, and Rameshbapu).

4. Results and Discussion

4.1. Strain distribution uniformity parameters

The result of a 90° stress distribution. The maximum stress distribution occurs at the corner angle, according to the results. The red colour indicates the maximum stress area, which has a value of 1.69810^8 N/m^2. Stress develops when the work piece passes through a tight corner angle, compressing the work piece and producing a higher stress area. The distribution of stress at angles of 110° and 130° as a result of the analysis. The stress distribution value is less at larger corner angles, as seen in the result. It occurs when the corner angle is increased, allowing the material to slide through with little resistance. At angles of 110° and 130°, the greatest stress values measured were 5.705$\times$10^7 N/m^2 and 1.328$\times$10^8 N/m^2, respectively. The pattern of strain as it passes through the die will change at the bottom, middle, and top of the work piece. The work piece was fed through a die with a predetermined corner angle; the smaller the angle of the die, the greater the strain value. The examination of strain at a 90° angle. The results show that the corner angle has the largest strain distribution, with a value of 1.899. Because a portion of the material remains undeformed at the end of the process, there is less strain from the top of the work piece to the bottom of the work piece when the work piece passes through a die at 110° than when the work piece passes through a die at 130°, as the strain values are minimal at the top and bottom of the work piece as shown in the results. The magnitude of angle 90° is greatest at the top of the work piece and lowest at the bottom. It demonstrates that the angle has little effect on magnitude because it does not occur at the corner angle. The maximum magnitude is found at the top of the work piece, with a value of 1.750. However, for angles of 110° and 130°, the entire work piece has the greatest magnitude from top to bottom. The effect of die channel angle on magnitude has an impact on the work piece's homogeneity. As can be seen, as the die channel angle is increased, the magnitude of the entire work piece increases, with values of 8.987 and 1.200 at 110° and 130°, respectively.

The response force during the ECAP process can be observed as a 0 value for angle 90°. When the sample entered the die and after passing through the corner angle, the reaction force occurred throughout the sample and had the same value. The reaction force analysis for angles of 110° and 130°. The increased channel angle is the result of the response force from the sample. The reaction force value for both analyses is 0 when the channel angle is increased. With the reaction force at 90 degrees, the effect is the same. The outcome of a punch force analysis for a 90° angle. As can be observed, the top of the sample has a greater value due to the load placed at the top of the sample to punch it downwards. If the load applied for this angle is more than 585, the result will appear as an error. At the commencement of the operation, when the punch pushes the work piece until it passes through the corner angle, the highest area of force is 1.678$\times$10^7 N/m^2. As a result, the work piece received a reduced force when it travelled through the corner angle. The force at angles of 110° and 130° was calculated to be 2.876×10^7 N/m^2 and 3.842×10^7 N/m^2, respectively. The highest force area begins when the work piece is pressed downwards and has the least force at the bottom of the work piece, according to the force applied on top of the work piece. As the force applied for both of these angles is 585 at maximum, increasing the channel angle influences the sample with a maximum force. As the force applied for both of these angles is 585 at maximum, increasing the channel angle influences the sample with a maximum force. This corresponds to a 9% difference between numerical and experimental results, which is suitable for all practical applications. The yield strength and ultimate tensile strength magnitudes, as well as failure due to elongation, for pure aluminium for commercial use up to 8 strokes via path A are shown in Table 1. As can be seen, the first pass results in considerable increases in terms of magnitudes of yield strength and ultimate tensile strength, followed by steady increases for successive passes.

The identical pattern had previously been seen. After the first and eighth passes, the YS and UTS values improved by 135 percent, 85 percent, and 300 percent, 140 percent, respectively. After the first and eighth passes, the elongation to failure was lowered by 55 percent and 75 percent, respectively. This means that as the number of passes increases, the ductility of aluminium decreases. Furthermore, Before and after 8 pass Equal Channel Angular Pressing, typical grain sizes are around 4 mm and 250 mm, respectively. Production, development of low angle grain boundaries, and multiplication, locking of dislocations, HAGBs, and lastly, synthesis of Ultra-fine Grain materials are all part of the ECAP process. To observe and study uniformity of strain distribution, two metrics (in homogeneity index (C_i) and standard deviation (S.D.)) were used. Route by route, increasing the number of passes The homogeneity of the strain distribution is reduced as a result of. So, C_i and S.D.values are expected to rise as the No. of strokes development. These conditions are the result of route A combining four die channel angles ((Φ=70^0, 90^0, 105^0, and 120^0) with three angles of outer corner (Ψ=0^0, 20^0 & $\pi - \Psi$) for up to 8 strokes. These shows were derived beginning with the 25 magnitudes of effective strains measured at the billet's mid-length cross-section. As can be seen in the graph, the homogeneity index decreases as the No. of strokes increment. It means that as the pass number rises, Equal Channel Angular Pressed aluminium with a uniform strain distribution emerges. This is in line with earlier experimental and numerical findings that show that increasing the pass number via route A causes non-uniform strain dispersal. Furthermore, it has been established that increasing the number of passes reduces the volume of fully processed material, resulting in Equal Channel Angular Pressed metals together a powerful texture or isotropic grist morphology. The degree of strain in homogeneity for route A Equal Channel Angular Pressed materials cannot be assessed using the C_i factor. The S.D. value, on the other hand, suggests that heterogeneity of strain is rising as the number of strokes grows. As a result, the Standard Deviation is a superior indicator of assessing the strain distribution homogeneity of Equal Channel Angular Pressed metal than C_i, at least for route A. adequate strain differential intermediate the random sample & the entire sample are measured in magnitudes.

4.2. Die design based on homogeneity of strain distribution

As can be seen, the best strain dispersal homogeneity can be achieved with value of Φ=60^0 and Ψ=15^0. as the best admixtures of and to get the lowest S.D. value in the transverse orientation for eight shoots. Furthermore, the die channel angle of 70^0 results in a higher effective strain magnitude than the other 5. The majority of Equal Channel Angular Pressing up until now, die design has been based on the effective strain magnitude.. Increasing the pass number can achieve a specific degree of grain fineness or strain effectiveness, but the creator feel that the majority of important component in this process the uniformity of strain distribution, As a result, homogeneous Equal Channel Angular Pressed materials are produced. It depicts the magnitude of the effective strain at the constituent and in the bulk of these samples for the three outer corner angles and four die channel angles up to 8 shoots via route A. As a result of the cross-position, section's the cross-effective section's strain value is greater or at slightest equivalent to that of the billet in its entirety. It could be linked to the non-deformed areas of the Equal Channel Angular Pressed metal in the sample's top and bottom. These parts exist because they are necessary, the overall sample's effective strain magnitude is lowered. The lowest and greatest variances in effective strain in the billet's cross-section and throughout for the cases of Φ=60^0, Ψ=15^0, and fourth shoot and Φ=105^0, Ψ=75^0, and eight pass, separately, are 0.04 and 1.98.

Regardless of the die parameters (Φ and Ψ), the dissimilarity value between the effective strain at the cross-section and whole of the sample increases as the pass number increases. For the 4 die channel angles and 3 outer corner angles, these are mean magnitudes computed from effective strain differences at the cross-section and whole of the sample. For the 4th die channel angle and 8th passes versus angle of the outer corner, The average difference between the effective strain at the billet's cross-section and entity is represented. Finally, the magnitude of strain that is effective differential at the random sample and across the workpiece is expressed for various angles of die channel. Finally, For various die channel angles, the size of effective strain differential at the cross-section and across the sample is mentioned. In this scenario, the differences are averaged over the three outside corner angles and eight passes. As a 1st shoot, Ψ=20^{0}and Φ=70^0,The Equal Channel Angular Pressed AA5083's strain changes between the cross-section and the entire are the least effective. Varying pass numbers, angle of the outer corner, and die channel angles have different S.D. values. For starters, for each die channel and angle of the outer corner, the magnitude of S.D. increases as the number of passes increases. This means that as the number of passes increases, the homogeneity of strain distribution in materials reduces. The magnitudes on average of S.D. derived from the three outer corner angles and four die channel angles for each pass code (up to 8 passes). Second, as previously said, we trust the die that produces higher isotropic ECAP material is more appropriate and important than the die that produces a higher effective strain value. This is for your consideration, the suitable mixture of ΦandΨ are (Φ=120^{0}andΨ = 20^0) and (Φ=120^{0}andΨ = 70^0), to both. For a die channel angle of 120^0 the magnitude of S.D. is nearly independent of the outer corner angle. Finally, the best parameters for die design for Equal Channel Angular Pressing of AA5083 are determined by the pass number, as mentioned in the ideal conditions of die design variables are Φ=120^0&Ψ = 15^0 or 60^0. AA5083 though the material provides greater strain distribution homogeneity under these die design settings, The size of the effective strain is not the greatest. escalation the number of shoots, on the other hand, can result in the desired number of effective strain.

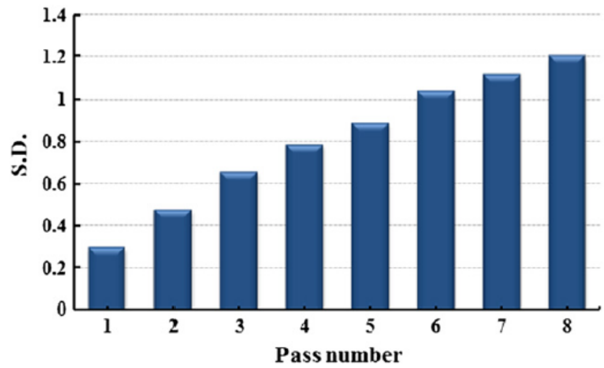

FIGURE 3. The average S.D. values for every pass number up to 8 passes, regardless of die channel and angles of outer corner.

According to the latest research, a set of 4 die channel angles (Φ=70^0, 90^0, 105^0& 120^0), 3 angles of outer corner (Ψ = 0^0, 20^0& π-Ψ) and route A has simulated pass counts (up to 8 passes). The effects of mentioned variables on size and distribution of effective strains behaviour are explored using two variables [homogeneity index (C_i) and standard deviation (S.D)] in the in the opposite direction and throughout the entire sample set. The following are some of the most important conclusions: The size of Standard Deviation.increment with enlarged shoots number for route A ECAP; i.e., growing shoot numbers achieves less uniformity of strain distribution. Given the substantial strain dispersion heterogeneity caused with growing shoot numbers, the homogeneity index (C_i) is not a good candidate for quantifying strain dispersal homogeneity. Deviation from the mean is a superior element for assessing the homogeneity of the spread of strains in Equal Channel Angular Pressed materials. one pass,Ψ = 20^0& Φ=70^0 are the main parameters for obtaining the smallest effective transverse plane strain variations and aggregate of the equal channel angular pressed aluminum. Φ=70^0&Ψ = 20^0 are the ideal parameter amount for designing ECAP dies depended on the best homogeneity of strain distribution amount the sample divisional Φ=120^0 &Ψ = 20^{0}or 70^{0}are the account of die angle of outer corner and channel angle for equal channel angular pressing die design to provide uniformity of strain dispensation at the bulk of the work piece in the experimental work, pure aluminium was submitted to ECAP dies with a channel angle of $90^0$and an angle of outer corner of 20^0 for up to eight shoot with path A. Increased Yield Strength and Ultimate Tensile Strength (about four and two times, respectively) as well as grain size reduction confirmed improved ECAPed aluminium characteristics (about 8 times).

5. Conclusion

Finally, the goal of determining the degree of influence of ECAP factors on aluminium alloy 5083 has been accomplished. The angle has an effect on the distorted sample, as seen in the results analysis. The dies channel angle has a bigger impact on the rise in effective plastic strain and maximum punch force, according to simulations. The punch force to the effect of stress and strain behaviour is influenced by the dies channel angle increase of around 20 degrees. Extruding the sample necessitates the use of pushing force. Since the sample had a 585 load pushed downwards, the applied force gives the maximum area on almost half of the sample. The pressing force creates a significant strain in the sample at a 90° channel angle. The increasing die channel angle at 110° and 130° generated a low strain distribution at values 0 and 4.981151, respectively, based on simulation findings. As a result, it may be inferred that the applied force has no effect on the strain behaviour as the channel angle increases. According to the research, ECAP dies channel angle can be designed to create a variety of engineering materials with small grain sizes and strong mechanical qualities, it is understood.

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